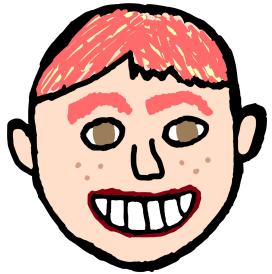
Functional Testing in Semiconductor Manufacturing

Tanner Carlson

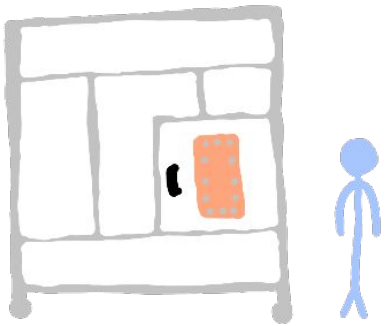
My Background

- Married with two cats
- Raised in the south playing soccer and producing music
- BS in Audio Engineering at Belmont University
  - Ocean Way Studios, Belmont Men’s Soccer, Tootsie’s Orchid Lounge
- First job: Audio-Visual Technician at UT Austin
- MS in Electrical Engineering at Columbia University
  - ETHER Lab, MP Lab, Synthesizer
- Systems engineer at Showy Inc. while in NYC
- Engineering technician at Applied Materials (Adecco)



Project Overview

- Producing systems for semiconductor fabrication facilities around the world
- Each tool has complex parts all working together worth ~$400k
  - Electrical wiring, mechanical structure, motors, polylines, fans, lasers, etc.
- Build technicians use a set of instructions with a written and visual element
- Test technicians use a procedure less explicit than build
- NPI group - working with new products, so more mistakes / fixes to make

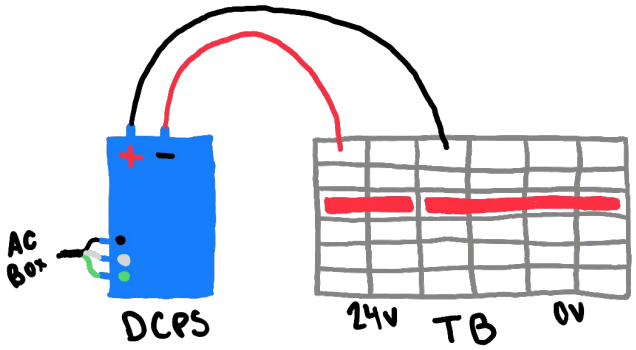


Module Testing

- My objective is to get each module ready to be integrated as a system for further testing
- Three main parts:
  - Checking **electrical wiring** - devices power on, no shorts between + and - voltages, and EMO buttons power off entire system
  - Setting up **communication** - IP address set correctly (xxx.xxx.xxx.xxx), the PC recognizes each device in its respective control software, and POE is routed through proper ports
  - Devices **function as intended** - PLC controls fan, motors reach full range of motion without faulting, vacuum turns on to hold wafer, cameras show an image, and pneumatic isolators do not oscillate

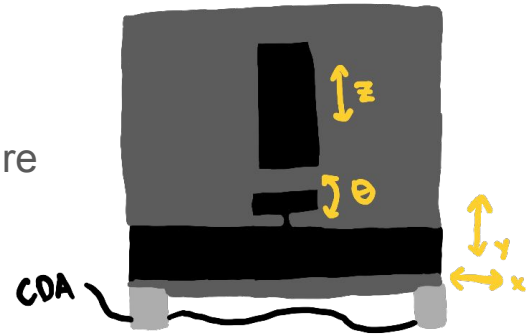
Problem #1: Incorrect Wiring

- First - notice a problem
  - USB hub not powering up
- Second - investigate why
  - Used multimeter to see 0V and 24V were swapped
  - Trace the problem back to the source of the DCPS
- Third - implement a fix
  - Flip the wires on the DCPS
- Fourth - ensure it doesn't happen again
  - Noticed that the instructions for the build technicians were wrong
  - Wrote a QN to formally notify engineering and management



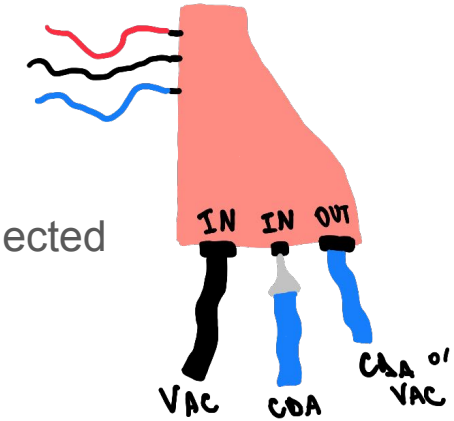
Problem #2: No Communication With Motor Controller

- Notice a problem
  - Motor does not connect to control application on PC
- Investigate why
  - Checked the wiring based on the schematic - all good
  - Noticed there was a flashing red LED on the hardware
  - Used manual & copilot to see it was a communication failure
- Implement a fix
  - Connect directly to the device and search the IP address
  - Change communication protocol to EtherCAT
- Ensure it doesn’t happen again
  - Notified our test engineer to update the procedure for the next modules



Problem #3: Wafer Vacuum

- Notice a problem
  - Vacuum is not engaging when the bit is turned on
- Investigate why
  - Three ports for polyline - only two used (CDA in & out)
  - Read manual to find there should be a vacuum pump connected
- Implement a fix
  - Connected vacuum pump and tested stage
- Ensure it doesn't happen again
  - Notified our test engineer to update the procedure



Outcome

Team Benefits

- Completed procedure on each occasion
- Tested two modules on time and two modules early (approx. 40 hours each)
- Issues with build instructions being found earlier in the process
- Freeing up valuable time for integrated testing

Individual Benefits

- Moving onto testing more complicated tools
- More rewarding work than build

Areas For Improvement

1. The time to find parts and hardware is incredibly long (2-3x actual work)
    a. When shipping parts, include all hardware, even lineside
    b. Place similar parts in a bin labeled by the beginning four digits of the part number
    c. Last resort would be to invest in more RFID scanners
2. The instructions are often incorrect and take weeks to correct
    a. Use incentives for writing QNs based on incorrect instructions
    b. Place a timeframe on when a QN is made to the time it is fixed
3. Logged hours are often inflated and do not account productivity
    a. Have a system in place to track completion percentages for each logged hour
    b. Promote top performers

How does this relate to high-volume manufacturing?

- Finding bottlenecks and waste
  - Scaling is an important aspect of any company - especially ones planning to grow
  - Spend more time on the front end discovering the BKMs
- Implementing creative solutions
  - Loose frameworks are a plus - build a system that promotes speed and flexibility
  - Evaluate trade-offs and see where the biggest difference can be made
- Amplifying an efficient workforce
  - Seconds begin to multiply when producing at a high scale
  - Compounding interest - 1% better each day results in a big change over time

Any questions?